

GRAPHpad

DIGITAL EQUIPMENT CORPORATION • MAYNARD, MASSACHUSETTS



GRAPHpad — an experimental computer-aided-design program

GRAPHpad is a general-purpose computer program being developed by Digital Equipment Corporation to demonstrate the versatility, speed, and ease of communicating with a running system program through the display subsystem. In such applications, the display is considerably more than an output device. It is actually functioning as a complete input channel and as an ancillary processor, complete with its own instruction set, which can perform a variety of tasks including some of the computations needed to construct the displayed image.

In this demonstration, the Type 340 Incremental CRT Display and the Type 370 High Speed Light Pen combine to let the user draw circuit diagrams. He can erase and revise them, then call for a paper-tape punchout which will thereafter reconstitute his drawing on the display. Hard-copy outputs available include photographic film and incremental plots.

Using GRAPHpad, he can select and position components, then connect them into various digital circuits to rapidly create complex drawings using only the Light Pen and control characters on the display as a real-time input channel. Auxiliary input devices are not required.

The Light Pen input programming typified in this demonstration by GRAPHpad is being developed by Digital to perform many design, synthesis, and analysis tasks. The element that these tasks have in common is the need to give the user close, immediate control over the system serving him. This close control is a basic requirement if the system is to give the user the extensive assistance it can. An ultimate goal at Digital is to speed up the design process not only by relieving the engineer of his drafting chores, as preliminary programs like GRAPHpad can, but also by simulating the dynamic performance of the circuits he draws. In minutes at the display, he could refine and revise, achieving better results than he can now in days of breadboarding. Proper positioning of components as circuits grow smaller is another goal.

Other programs that have been developed for use with the PDP-4 and Type 340 Display plot up to five general polynomial graphs overlaying each other for graphic solutions of simultaneous linear equations, plot sine harmonics, and illustrate conic sections, ellipses, hyperbolas, and parabolas. The optional Type 342 Character Generator and the other operating modes of the Type 340 are discussed in the Precision Incremental Display product bulletin. For information about an optional display monitor or the sub-routining capability of the Type 340, contact Digital's Sales Department at 146 Main St., Maynard, Mass. Or call the Digital office near you.

The GRAPHpad Program

GRAPHpad incorporates several provisions to increase the efficiency of the circuit designer and to reduce program storage requirements.

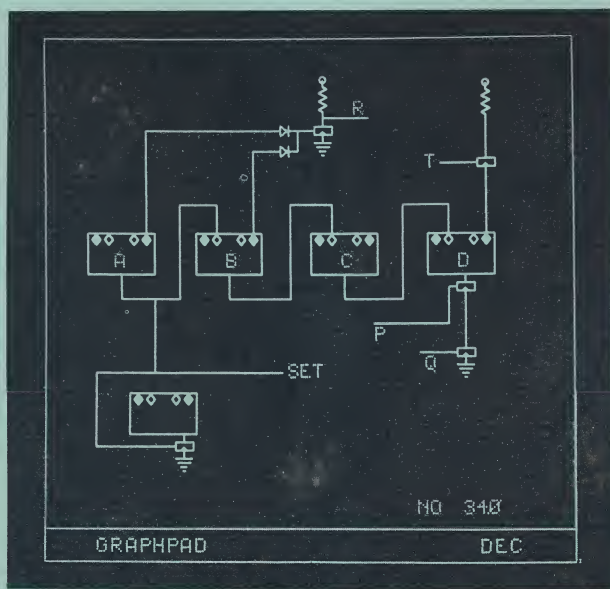
A primary step for gaining efficiency was to give the user a data and command input channel that is complete in the display and Light Pen. He can act and react more quickly with it, and his train of thought is not inter-

rupted by having to turn away from the display to type in commands or data on a keyboard. Putting information in with the Light Pen is quite close to normal design sketching, and it eliminates many conventional drafting chores. Components can be repeated quickly, for example, and a variety of locations can easily be tried to find optimum layouts.

To further increase the user's effectiveness, GRAPHpad simplifies component placement and eliminates pen movement problems that arise in computer-aided drawing. A principal difficulty in programs using a pen-following scan is the loss or misplacement of symbols through too-rapid or off-screen pen movements. Moving the pen slowly, "dragging" the component into place, is usually the solution, but in GRAPHpad the problems were eliminated by using a pen-finding scan. The user swings the pen as rapidly as he wants, on or off-screen, without losing the component. It will appear on the display wherever he points the pen.

Placement is significantly easier because of the raster used in GRAPHpad, a 15,000-point grid much like the auxiliary lines on graph paper. Component and lead dimensions are chosen to take maximum advantage of the grid in connecting and placing circuit elements.

Storage requirements can easily become excessive when using a computer-aided-drawing program to design the multibit, parallel-processing circuits used in modern systems. A flip flop can require 30 to 40 memory words, for example, and some diagrams can include 72 or more flip flops. GRAPHpad conserves on storage by specifying and positioning a flip flop with only five words: two for the x, y position, two control words, and one pointer word (containing the address of the flip flop section of the permanent symbol table). This program technique of data table construction, together with table consolidation whenever an element is "erased," keeps the entire program, including data tables, to the 3400 words GRAPHpad uses in this demonstration.



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